JANYU TECHNOLOGIES PRIVATE LIMITED

No 17, Ground Floor, Building No 6, Rajprabha Landmark Industrial Estate, Sy No 33 42/1 43/1, Sativali Road, Gokhivare, Vasai East, Palghar Dist., Maharashtra-401208, India

To
Shri Syed Tausif Abbas,
Advisor (Networks, Spectrum and Licensing),
Telecom Regulatory Authority of India
TRAI
Email ID advmn@trai.gov.in.
Subject: TRAI Consultation Paper on Auction of Spectrum in frequency bands identified for IMT/5G 30th November 2021

Dear Sir
We represent Janyu Tech, Mumbai, India, a Technology Company registered in India in 2016 as per Indian Company Act.
We see internet connectivity is the basic need of the people. We also note high market potential for internet based services in India. Janyu Tech is planning India based Low Earth Orbit (LEO) Satellite System. Janyu Tech is in the process of designing and building LEO Communication Satellite System "ASTROCOM", consisting of a constellation of 99 Satellites. We are planning to use Ku and KA band spectrum for implementing ASTROCOM Satellite System.
We are submitting herewith our inputs to TRAI in the context of TRAI Consultation Paper on Auction of Spectrum in frequency bands identified for IMT/5G 30th November 2021 to emphasize the need of KA Band in particular the sub band 27.5-29.1 GHz for Non GSO Communication Satellite Systems. The considerations presented in this submission clearly indicate that 28 GHz Band (27.5-29.1 GHz) must be deferred for Auction for 5G/IMT Services.
We also enclose a brief write up on Janyu Tech Pvt Ltd for kind information.

Thanking You
Yours Sincerely

Abhimanyu Raja

JANYU TECHNOLOGIES PVT. LTD. VASAI (EAST)

JANYU TECH

CIN No.: - U31900MH2016PTC283131

JANYU TECHNOLOGIES PRIVATE LIMITED

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About Janyu Tech

Janyu Tech is a well established and reputed company based in Mumbai, India.

- Year of establishment : 2016
- Has a good reputation in Industrial Robotics and Automation for variety of applications ranging from Industrial maintenance, Smart city maintenance, and Covid management.
- Blue Chip Clients spread around many countries, including many public and private sector companies.
- Janyu Tech has ventured into Telecom domain and provides technical expertise and consultancy for variety of Telecom ventures that involves telecom network planning, development and commissioning of Telecom infrastructure and Telecom services that includes following:
- 5G services via Satellite to cater to Indian as well as foreign markets. Janyu envisions to provide cutting edge telecom network solutions to variety of industrial and domestic needs of consumers. This will also open up new market areas and innovative solutions that will enhance productivity and profitability of businesses.
- VSAT and other satellite based telecom services for wide range of applications.
- Digital automation and connectivity.
- Cumulative man years of Telecom & SATCOM Experience: 108 years

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INPUT TO TRAI
ON KA BAND FREQUENCY ALLOCATIONS AVAILABLE FOR NON GSO COMMUNICATION SATELLITE SYSTEMS

1 Introduction

In the KA band frequency range, the frequency bands 27-31 GHz and 17.7-21.2 GHz have been allocated for fixed satellite service and this corresponds to the total frequency spectrum of 4000 MHz and 3500 MHz in the Satellite Uplink and Satellite Downlink directions respectively. In the last 25 years or so ITU WRCs imposed several regulatory conditions enabling as well as regulating use of this part of the spectrum for Non-Geostationary Communication Satellite Systems (NGSO). For implementing NGSO Systems the sub bands 29.1-29.5 GHz and 30-31 GHz in the Uplink and 17.7-17.8 GHz, 18.6-18.8 GHz, 19.3-19.7 GHz, 20.2-21.2 GHz in Downlink are avoided due to ITU frequency allocation reasons as discussed in the enclosed ANNEXURE 1. In view of these considerations especially from the ITU Frequency Allocations point of view, spectrum available for Non-Geostationary Communication Satellite Systems in the KA band frequency range is as follows:

KA BAND DOWNLINK: 1800 MHz
(17.8-18.6 GHz; 18.8 to 19.3 GHz, 19.7-20.2 GHz)

Ku BAND DOWNLINK: 2050 MHz
(10.7-12.75 GHz)

KA BAND UPLINK: 2100 MHz
(27.5-28.6 GHz; 28.6-29.1 GHz; 29.5-30 GHz)

Ku BAND UPLINK: 1250 MHz
(12.75-13.25 GHz; 13.75-14.5 GHz)

2 26 GHz and 28 GHz Band Considerations in the context of 5G

In the context of 5G/IMT, Regulatory situation for the 26 GHz and 28 GHz bands is getting developed.

2.1 ITU Frequency Allocation Situation in 27 - 28 GHz Band

2.1.1 The Frequency Band 24.25-27.5 GHz is identified for the terrestrial component of IMT (International Mobile Telecommunications) as per ITU RR No. **5.532AB.**

5.532AB The frequency band 24.25-27.5 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which it is allocated and does not establish priority in the Radio Regulations. Resolution **242 (WRC-19)** applies. (WRC-19)

2.1.2 WRC-19 Conference has not identified the Frequency Band 27.5-28.5 GHz for IMT.

27.5-28.5	FIXED 5.537A FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.517A 5.539 MOBILE 5.538 5.540

2.2 DOT

DOT has requested TRAI to provide band plan for auctioning spectrum including the entire band 24.25-28.5 GHz except for 5 locations with protection distance of 2.7 km.

Extracts from DOT Letter dated 13-9-2020

(a) provide recommendations on applicable reserve price, band plan, block size, quantum of spectrum to be auctioned and associated conditions for auction of spectrum in 526-698 MHz, 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300-3670 MHz and 24.25-28.5 GHz bands for IMT/ 5G.

(iv) 24.25 to 28.5 GHz in all the LSAs except at 5 locations (details of locations in ***Annexure-II***) with protection distance of 2.7 km.

2.3 TRAI CP (Consultation Paper date 30-11-2021)

As per TRAI report, eco system is getting developed in both bands (26 GHz and 28 GHz bands).

Extract from TRAI CP (date 30-11-2021):

2.35 While in WRC-19, 24.25 – 27.5 GHz has been identified for IMT, some of the countries such as USA, Japan, Korea have also opened up 28 GHz band (26.5 – 29.5 GHz) for IMT/5G. However, Europe has decided to go for 26 GHz band. Therefore, ecosystem is getting developed in both these bands.

2.34 DoT through its reference dated 13th September 2021 has, for the first time proposed to include 24.25 – 28.5 GHz band amongst the bands to be auctioned in the forthcoming auction. DoT has also informed that 24.25 to 28.5 GHz band will be used exclusively for IMT/5G except certain portion of this frequency range at 5 locations at Delhi, Shadnagar (Hyderabad), Khambaliya (Gujarat), Hut Bay (A&N Islands) and Tirunelveli (Tamilnadu) with protection distance of 2.7 Km.

2.4 ITU STUDIES

In accordance with ITU Resolution 173 (Please see ANEXURE 2) adopted by WRC-19 Conference, ITU Radiocommunication Sector (ITU-R) has begun preliminary studies on the technical and operational issues associated with the use of non-geostationary (non-GSO) satellites transmitting towards the geostationary-satellite orbit (GSO) in the FSS frequency band 27.5-30 GHz, and that such studies are expected to continue in this frequency band and other frequency bands..

In view of the above, ITU studies will come out with recommendation on technical guide lines for frequency sharing between GSO and Non GSO systems.

2.5 EUROPE

Preliminary CEPT position (continued): Regarding the 17.7-19.7 GHz band, CEPT is of the view that ESIM shall not claim protection from the fixed and mobile services in the band. Regarding the 27.5-29.5 GHz band, the CEPT supports studying appropriate sharing techniques, including e.i.r.p. or pfd values for ESIM in order to protect the fixed and mobile services allocated in the bands. CEPT has developed a Roadmap on 5G (http://www.cept.org/ecc/topics/spectrum-for-wireless-broadband-5g#roadmap). In this respect it is noted that "Europe has harmonised the 27.5-29.5 GHz band for broadband satellite and is supportive of the worldwide use of this band for ESIM. This band is therefore not available for 5G".

2.6 ITU CONTRIBUTION

https://www.itu.int/en/mediacentre/backgrounders/Pages/Earth-stations-in-motion-satellite-issues.aspx

ITU Member States agreed at the WRC-19 in Sharm el-Sheikh, Egypt to a new Resolution that will boost the deployment of ESIM.

To address the increasing need for radio-frequency spectrum for ESIM, while protecting other services, WRC-19 agreed decided on the regulatory and technical conditions under which the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) can be used by the three types of ESIM communicating with geostationary (GSO) space stations in the fixed-satellite service (FSS).

The new Resolution starts by stating that "there is a need for global broadband mobile-satellite communications, and that some of this need could be met by allowing earth stations in motion (ESIMs) to communicate with space stations of the geostationary-satellite orbit (GSO) fixed-satellite service (FSS) operating in the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space)."

However, the Resolution also cautions that the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) "are also allocated to terrestrial and space services used by a variety of different systems, and these existing services and their future development need to be protected, without the imposition of undue constraints, from the operation of ESIMs."

Considering the above, the Resolution lays out technical, operational and regulatory conditions for any ESIM communicating with a GSO FSS space station in the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz, or parts thereof.

WRC-19 also decided to continue studies on this issue for the next WRC scheduled in 2023, where the use of the frequency bands 17.7-18.6 GHz, 18.8-19.3 GHz and 19.7-20.2 GHz (space-to-Earth) and 27.5-29.1 GHz and 29.5-30 GHz (Earth-to-space) by ESIM communicating with non-geostationary satellites in the fixed-satellite service will be addressed together with a potential additional 500 MHz of new spectrum being identified for ESIM communicating with geostationary satellites in the fixed-satellite service in the frequency band 12.75-13.25 GHz (Earth-to-space).

3 Non GSO Satellite Constellation Frequency Plan Information

Many of the Non GSO Systems in the process of implementation/operation use the band 27.5-29.1 GHz.

The frequency bands planned by selected Non GSO Systems are given in the ANNEXURE 3.

4 Deferment of 28 GHz Band (27.5-29.1 GHz) for Auction for 5G/IMT Services

The considerations presented in this submission clearly indicate that 28 GHz Band (27.5-29.1 GHz) must be deferred for Auction for 5G/IMT Services.

ANNEXURE 1

Regulatory Restrictions on Certain KA Sub Bands

1 Regulatory Restrictions on Certain KA Band Uplink Sub Bands

1.1 29.1-29.5 GHz (Earth-to-space)

As per ITU RR 5.541A, there is a regulatory requirement to use adaptive power control or other methods of fade compensation in the 29.1-29.5 GHz band.

5.541A Feeder links of non-geostationary networks in the mobile-satellite service and geostationary networks in the fixed-satellite service operating in the band 29.1-29.5 GHz (Earth-to-space) shall employ uplink adaptive power control or other methods of fade compensation, such that the earth station transmissions shall be conducted at the power level required to meet the desired link performance while reducing the level of mutual interference between both networks. These methods shall apply to networks for which Appendix **4** coordination information is considered as having been received by the Bureau after 17 May 1996 and until they are changed by a future competent world radiocommunication conference. Administrations submitting Appendix **4** information for coordination before this date are encouraged to utilize these techniques to the extent practicable. (WRC-2000)

1.2 30.0 – 31.0 GHz (Earth-to-space)

30-31	FIXED-SATELLITE (Earth-to-space) 5.338A MOBILE-SATELLITE (Earth-to-space) Standard frequency and time signal-satellite (space-to-Earth) 5.542

5.338A In the frequency bands 1 350-1 400 MHz, 1 427-1 452 MHz, 22.55-23.55 GHz, 24.25-27.5 GHz, 30-31.3 GHz, 49.7-50.2 GHz, 50.4-50.9 GHz, 51.4-52.4 GHz, 52.4-52.6 GHz, 81-86 GHz and 92-94 GHz, Resolution **750 (Rev.WRC-19)** applies. (WRC-19)

5.542 *Additional allocation:* in Algeria, Saudi Arabia, Bahrain, Brunei Darussalam, Cameroon, China, Congo (Rep. of the), Egypt, the United Arab Emirates, Eritrea, Ethiopia, Guinea, India, Iran (Islamic Republic of), Iraq, Japan, Jordan, Kuwait, Lebanon, Malaysia, Mali, Morocco, Mauritania, Nepal, Oman, Pakistan, Philippines, Qatar, the Syrian Arab Republic, the Dem. People's Rep. of Korea, Somalia, Sudan, South Sudan, Sri Lanka and Chad, the band 29.5-31 GHz is also allocated to the fixed and mobile services on a secondary basis. The power limits specified in Nos. **21.3** and **21.5** shall apply. (WRC-12)

ii) No EPFD Limits for the 30-31 GHz Band (Please see TABLE 22-2) and ITU RR Provision 22.2 applies for the 30-31 GHz Band

ITU RR Provision 22.2 applies for the band 30-31 GHz.

The implication is non-geostationary satellite systems shall cease the operations, in case of any objections by the operators of GSO systems.

22.2 § 2 1) Non-geostationary-satellite systems shall not cause unacceptable interference to and, unless otherwise specified in these Regulations, shall not claim protection from geostationary-satellite networks in the fixed-satellite service and the broadcasting-satellite service operating in accordance with these Regulations. No. **5.43A** does not apply in this case. (WRC-07)

TABLE **22-2** (WRC-03)

Limits to the epfd↑ radiated by non-geostationary-satellite systems in the fixed-satellite service in certain frequency bands[15]

Frequency band	epfd↑ (dB(W/m^2))	Percentage of time epfd↑ level may not be exceeded	Reference bandwidth (kHz)	Reference antenna beamwidth and reference radiation pattern[16]
5 925-6 725 MHz	−183.0	100	4	1.5° Recommendation ITU-R S.672-4, $Ls = -20$
12.5-12.75 GHz 12.75-13.25 GHz 13.75-14.5 GHz	−160	100	40	4° Recommendation ITU-R S.672-4, $Ls = -20$
17.3-18.1 GHz (Regions 1 and 3) 17.8-18.1 GHz (Region 2) [17]	−160	100	40	4° Recommendation ITU-R S.672-4, $Ls = -20$
27.5-28.6 GHz	−162	100	40	1.55° Recommendation ITU-R S.672-4, $Ls = -10$
29.5-30 GHz	−162	100	40	1.55° Recommendation ITU-R S.672-4, $Ls = -10$

iii) 30-31 GHz for Military Use

https://halberdbastion.com/technology/military/nato-joint-civil-and-military-frequency-agreement-njfa

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155 **22.5D.2** In meeting these limits, the administrations intending to develop such systems shall ensure that the assignments appearing in the Plans of Appendices **30A** and **30B** will be fully protected. (WRC-2000)

16 **22.5D.3** For this Table, reference patterns of Recommendation ITU-R S.672-4 shall be used only for the calculation of interference from non-geostationary-satellite systems in the fixed-satellite service into geostationary-satellite systems in the fixed-satellite service. For the case of $Ls = -10$, the values $a = 1.83$ and $b = 6.32$ shall be used in the equations in Annex 1 to Recommendation ITU-R S.672-4 for single-feed circular beams. In all cases of Ls, the parabolic main beam equation shall start at zero. (WRC-2000)

17 **22.5D.4** This epfd↑ level also applies to the frequency band 17.3-17.8 GHz to protect broadcasting-satellite service feeder links in Region 2 from non-geostationary fixed-satellite service Earth-to-space transmissions in Regions 1 and 3. (WRC-2000)

EXTRACT

30-31 GHz	FIXED-SATELLITE (s-E) MOBILE-SATELLITE (s-E)	Military requirements for planned satellite uplinks	This is a harmonised NATO band type 2

2 Regulatory Restrictions on Certain KA Band Downlink Sub Bands

2.1 Constraints in using the sub band 17.7-17.8 GHz

i) Please note as per ITU RR No. 5.516, "The use of the band 17.3-17.8 GHz in Region 2 by systems in the fixed-satellite service (Earth-to-space) is limited to geostationary satellites."

As per ITU RR No. 517, "In Region 2, use of the fixed-satellite (space-to-Earth) service in the band 17.7-17.8 GHz shall not cause harmful interference to nor claim protection from assignments in the broadcasting-satellite service operating in conformity with the Radio Regulations."

5.516 The use of the band 17.3-18.1 GHz by geostationary-satellite systems in the fixed-satellite service (Earth-to-space) is limited to feeder links for the broadcasting-satellite service. The use of the band 17.3-17.8 GHz in Region 2 by systems in the fixed-satellite service (Earth-to-space) is limited to geostationary satellites. For the use of the band 17.3-17.8 GHz in Region 2 by feeder links for the broadcasting-satellite service in the band 12.2-12.7 GHz, see Article **11**. The use of the bands 17.3-18.1 GHz (Earth-to-space) in Regions 1 and 3 and 17.8-18.1 GHz (Earth-to-space) in Region 2 by non-geostationary-satellite systems in the fixed-satellite service is subject to application of the provisions of No. **9.12** for coordination with other non-geostationary-satellite systems in the fixed-satellite service. Non-geostationary-satellite systems in the fixed-satellite service shall not claim protection from geostationary-satellite networks in the fixed-satellite service operating in accordance with the Radio Regulations, irrespective of the dates of receipt by the Bureau of the complete coordination or notification information, as appropriate, for the non-geostationary-satellite systems in the fixed-satellite service and of the complete coordination or notification information, as appropriate, for the geostationary-satellite networks, and No. **5.43A** does not apply. Non-geostationary-satellite systems in the fixed-satellite service in the above bands shall be operated in such a way that any unacceptable interference that may occur during their operation shall be rapidly eliminated. (WRC-2000)

5.516A In the band 17.3-17.7 GHz, earth stations of the fixed-satellite service (space-to-Earth) in Region 1 shall not claim protection from the broadcasting-satellite service feeder-link earth stations operating under Appendix **30A**, nor put any limitations or restrictions on the locations of the broadcasting-satellite service feeder-link earth stations anywhere within the service area of the feeder link. (WRC-03)

5.517 In Region 2, use of the fixed-satellite (space-to-Earth) service in the band 17.7-17.8 GHz shall not cause harmful interference to nor claim protection from assignments in the broadcasting-satellite service operating in conformity with the Radio Regulations. (WRC-07)

ii) As per ITU RR Table 22-1B, EPFD limits are not specified for 17.7-17.8 GHz Band

TABLE **22-1B** (WRC-03)

Limits to the epfd↓ radiated by non-geostationary-satellite systems in the fixed-satellite service in certain frequency bands[3, 6, 8]

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[8] **22.5C.7** A non-geostationary-satellite system shall meet the limits of this Table in both the 40 kHz and the 1 MHz reference bandwidths. (WRC-2000)

Frequency band (GHz)	epfd↓ (dB(W/m^2))	Percentage of time during which epfd↓ may not be exceeded	Reference bandwidth (kHz)	Reference antenna diameter and reference radiation pattern[7]
17.8-18.6	−175.4 −175.4 −172.5 −167 −164 −164	0 90 99 99.714 99.971 100	40	1 m Recommendation ITU-R S.1428-1
	−161.4 −161.4 −158.5 −153 −150 −150	0 90 99 99.714 99.971 100	1 000	

iii) In view of the above considerations, the down link frequency plan starts from **17.8 GHz** and not 17.7 GHz

2.2 Constraints on the sub band 18.6-18.8 GHz

i) As per 5.522B, "The use of the band 18.6-18.8 GHz by the fixed-satellite service is limited to geostationary systems and systems with an orbit of apogee greater than 20 000 km."

5.522A The emissions of the fixed service and the fixed-satellite service in the band 18.6-18.8 GHz are limited to the values given in Nos. **21.5A** and **21.16.2**, respectively. (WRC-2000)

5.522B The use of the band 18.6-18.8 GHz by the fixed-satellite service is limited to geostationary systems and systems with an orbit of apogee greater than 20 000 km. (WRC-2000)

21.5 3) The power delivered by a transmitter to the antenna of a station in the fixed or mobile services shall not exceed +13 dBW in frequency bands between 1 GHz and 10 GHz, or +10 dBW in frequency bands above 10 GHz, except as cited in No. **21.5A**. (WRC-2000)

21.5A As an exception to the power levels given in No. **21.5**, the sharing environment within which the Earth exploration-satellite (passive) and space research (passive) services shall operate in the band 18.6-18.8 GHz is defined by the following limitations on the operation of the fixed service: the power of each RF carrier frequency delivered to the input of each antenna of a station in the fixed service in the band 18.6-18.8 GHz shall not exceed −3 dBW. (WRC-2000)

8 **21.16.2** In addition to the limits given in Table **21-4**, in the band 18.6-18.8 GHz the sharing environment within which the Earth exploration-satellite (passive) and space research (passive) services shall operate is defined by the following limitations on the operation of the fixed-satellite service: the power flux-density across the 200 MHz band 18.6-18.8 GHz produced at the surface of the Earth by emissions from a space station under assumed free-space propagation conditions shall not exceed −95 dB(W/m^2), except for less than 5% of time, when the limit may be exceeded by up to 3 dB. The provisions of No. **21.17** do not apply in this band. (WRC-2000)

ii) In view of the above considerations, the frequency band 18.6-18.8 GHz is not used for non geostationary satellite systems.

2.3 Constraints on the sub band 19.3-19.7 GHz

i) As per 5.523D, ITU RR Provision 22.2 applies for the sub band 19.3-19.7 GHz if this band is used for FSS.

The implication is non-geostationary satellite systems shall cease the operations, in case of any objections by the operators of GSO systems.

However if this band 19.3-19.7 GHz is used for feeder links to MSS, ITU RR Provision 22.2 does not apply.

5.523D The use of the band 19.3-19.7 GHz (space-to-Earth) by geostationary fixed-satellite service systems and by feeder links for non-geostationary-satellite systems in the mobile-satellite service is subject to the application of the provisions of No. **9.11A**, but not subject to the provisions of No. **22.2**. The use of this band for other non-geostationary fixed-satellite service systems, or for the cases indicated in Nos. **5.523C** and **5.523E**, is not subject to the provisions of No. **9.11A** and shall continue to be subject to Articles 9 (except No. **9.11A**) and **11** procedures, and to the provisions of No. **22.2**. (WRC-97)

22.2 § 2 1) Non-geostationary-satellite systems shall not cause unacceptable interference to and, unless otherwise specified in these Regulations, shall not claim protection from geostationary-satellite networks in the fixed-satellite service and the broadcasting-satellite service operating in accordance with these Regulations. No. **5.43A** does not apply in this case. (WRC-07)

ii) EPFD Limits are not specified for the 19.3-19.7 GHz.

iii) In view of the above considerations ONEWEB, TELESAT, STARLINK VIASAT do not use the sub band 19.3-19.7 GHz.

But KUIPER uses the 19.3-19.7 GHz band.

2.4 KA BAND 20.2-21.2 GHz

i) ITU Frequency Allocation Consideration:

ITU RR Provision 22.2 applies for the band 20.2-21.2 GHz.

The implication is non-geostationary satellite systems shall cease the operations, in case of any objections by the operators of GSO systems.

22.2 § 2 1) Non-geostationary-satellite systems shall not cause unacceptable interference to and, unless otherwise specified in these Regulations, shall not claim protection from geostationary-satellite networks in the fixed-satellite service and the broadcasting-satellite service operating in accordance with these Regulations. No. **5.43A** does not apply in this case. (WRC-07)

EPFD Limits are specified for 17.8-18.6 GHz and 19.7-20.2 GHz bands.

But EPFD Limits are not specified for the 20.2-21.2 GHz. The implication is that EPFD limits may not be adequate to protect GSO Systems. In view of this commercial systems avoid the 20.2-21.2 GHz band.

ii) 20.2-21.2 GHz for Military Use

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EXTRACT

20.2-21.2 GHz	FIXED-SATELLITE (s-E) MOBILE-SATELLITE (s-E)	Essential military requirements for satellite downlinks.	1. This is a harmonised NATO band type 1, including ITU Region 2. 2. The MOBILE-SATELLITE allocation is paired with 43.5-45.5 GHz

The implication is non-geostationary satellite systems shall cease the operations, in case of any objections by the operators of GSO systems.

However if this band 19.3-19.7 GHz is used for feeder links to MSS, ITU RR Provision 22.2 does not apply.

5.523D The use of the band 19.3-19.7 GHz (space-to-Earth) by geostationary fixed-satellite service systems and by feeder links for non-geostationary-satellite systems in the mobile-satellite service is subject to the application of the provisions of No. **9.11A**, but not subject to the provisions of No. **22.2**. The use of this band for other non-geostationary fixed-satellite service systems, or for the cases indicated in Nos. **5.523C** and **5.523E**, is not subject to the provisions of No. **9.11A** and shall continue to be subject to Articles **9** (except No. **9.11A**) and **11** procedures, and to the provisions of No. **22.2**. (WRC-97)

22.2 § 2 1) Non-geostationary-satellite systems shall not cause unacceptable interference to and, unless otherwise specified in these Regulations, shall not claim protection from geostationary-satellite networks in the fixed-satellite service and the broadcasting-satellite service operating in accordance with these Regulations. No. **5.43A** does not apply in this case. (WRC-07)

ii) EPFD Limits are not specified for the 19.3-19.7 GHz.

iii) In view of the above considerations ONEWEB, TELESAT, STARLINK VIASAT do not use the sub band 19.3-19.7 GHz.

But KUIPER uses the 19.3-19.7 GHz band.

2.4 KA BAND 20.2-21.2 GHz

i) ITU Frequency Allocation Consideration:

ITU RR Provision 22.2 applies for the band 20.2-21.2 GHz.

The implication is non-geostationary satellite systems shall cease the operations, in case of any objections by the operators of GSO systems.

22.2 § 2 1) Non-geostationary-satellite systems shall not cause unacceptable interference to and, unless otherwise specified in these Regulations, shall not claim protection from geostationary-satellite networks in the fixed-satellite service and the broadcasting-satellite service operating in accordance with these Regulations. No. **5.43A** does not apply in this case. (WRC-07)

EPFD Limits are specified for 17.8-18.6 GHz and 19.7-20.2 GHz bands.

But EPFD Limits are not specified for the 20.2-21.2 GHz. The implication is that EPFD limits may not be adequate to protect GSO Systems. In view of this commercial systems avoid the 20.2-21.2 GHz band.

ii) **20.2-21.2 GHz for Military Use**

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EXTRACT

20.2-21.2 GHz	FIXED-SATELLITE (s-E) MOBILE-SATELLITE (s-E)	Essential military requirements for satellite downlinks.	1. This is a harmonised NATO band type 1, including ITU Region 2. 2. The MOBILE-SATELLITE allocation is paired with 43.5-45.5 GHz

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ANNEXURE 2

RESOLUTION 173 (WRC-19)

Use of the frequency bands 17.7-18.6 GHz, 18.8-19.3 GHz and 19.7-20.2 GHz (space-to-Earth) and 27.5-29.1 GHz and 29.5-30 GHz (Earth-to-space) by earth stations in motion communicating with non-geostationary space stations in the fixed-satellite service

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

a) that the frequency bands 17.7-18.6 GHz, 18.8-19.3 GHz and 19.7-20.2 GHz (space-to-Earth) and 27.5-29.1 GHz and 29.5-30 GHz (Earth-to-space) are globally allocated on a co-primary basis to the fixed-satellite service (FSS), and that there are a number of non-geostationary-satellite systems (non-GSO) operating or planned to operate in these frequency bands;

b) that the fixed and mobile services are allocated on a primary basis in the frequency bands 17.7-17.8 GHz, 18.1-19.7 GHz and 27.5-29.5 GHz on a global basis* and the fixed service is also allocated on a primary basis in the frequency band 17.8-18.1 GHz on a global basis;

c) that the frequency band 28.5-30 GHz (Earth-to-space) is allocated to the Earth exploration-satellite service (EESS) on a secondary basis, and no additional constraints should be imposed on the EESS;

d) that the frequency band 29.95-30 GHz may be used for space-to-space links in the EESS on a secondary basis, and no additional constraints should be imposed on the EESS;

e) that there are existing and planned non-GSO satellite constellations in the frequency bands 17.7-20.2 GHz (space-to-Earth) and 27.5-30 GHz (Earth-to-space) and that these constellations are designed to serve the growing need for access to broadband connectivity, regardless of location;

f) that existing regulatory and technical procedures apply in the segments of the frequency bands listed in *considering a)* between geostationary-satellite (GSO) FSS networks and non-GSO FSS systems;

g) that the frequency bands listed in *considering a)* are also allocated to several other services on a primary basis, that those services are used by a variety of different systems in many administrations and that these existing services and their future development should be protected without undue constraints;

h) that, in accordance with the relevant provisions of Articles **9** and **11**, non-GSO FSS networks intending to operate in the frequency bands detailed in *considering a)* should be coordinated and notified;

i) that there is a need for mobile-satellite communications, including global satellite broadband, and that part of this need can be met by allowing earth stations in motion (ESIMs) to communicate with FSS space stations operating in the frequency bands detailed in *considering a)*;

j) that a consistent approach to the deployment of these ESIMs will support important and growing global communication requirements and provide adequate protection to other services in the frequency bands;

k) that, currently, there is no specific regulatory procedure for the coordination of ESIMs relative to terrestrial stations for these services,

considering further

a) that there is no methodology on how to protect GSO FSS space stations from ESIMs communicating with non-GSO FSS systems;

b) that there is no information on the coordination agreements reached among administrations between GSO FSS satellite networks and non-GSO FSS systems in those frequency bands where No. **5.523A** applies;

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* *Note by the Secretariat*: The band 17.7-17.8 GHz is allocated to the mobile service on a secondary basis in Region 2.

c) that there is no established and agreed interference management procedure to address the potential interference arising from the use of ESIMs communicating with non-GSO FSS systems referred to in this Resolution, and the responsibility of the entities involved in this operation is not defined;

d) that ESIMs communicating with non-GSO FSS systems should be operated within the envelope of the characteristics and envelope of coordination of specific and/or typical earth stations of the non-GSO FSS systems initially published and included in the International Frequency Information Circular (BR IFIC);

e) that there is no established methodology to calculate the equivalent power flux-density (epfd) from the use of multiple non-GSO FSS systems in the frequency bands detailed in *considering a)*,

noting

a) that Resolution **156 (WRC-15)** addresses the use of ESIMs communicating with GSO space stations in the FSS in the frequency bands 19.7-20.2 GHz and 29.5-30.0 GHz;

b) that Resolution **158 (WRC-15)*** calls for studies for the use of ESIMs communicating with GSO space stations in the FSS in the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz;

c) that this conference has adopted Resolution **169 (WRC-19)**, which contains the technical, operational and regulatory provisions for ESIMs communicating with GSO FSS networks in the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz, under the conditions contained in that Resolution,

recognizing

a) that technical and operational requirements for ESIMs, which prior to WRC-15 were referred to as earth stations on mobile platforms ("ESOMPs") operating with non-GSO FSS systems in the frequency bands detailed in *considering a)* above have been discussed in the ITU Radiocommunication Sector (ITU-R) and are reflected in the Report ITU-R S.2261;

b) that Article **21** determines power flux-density (pfd) limits applicable to non-GSO FSS systems to protect fixed and mobile land stations;

c) that Article **22** contains epfd limits for non-GSO FSS systems in the frequency bands 17.8-18.6 GHz, 19.7-20.2 GHz (space-to-Earth), 27.5-28.6 GHz (Earth-to-space), 29.5-30 GHz (Earth-to-space) and 17.8-18.4 GHz (inter-satellite);

d) that the use of the frequency band 19.3-19.6 GHz (Earth-to-space) by the FSS is limited to GSO systems and feeder links to non-GSO systems in the mobile-satellite service (MSS), in accordance with No. **5.523D**;

e) that the use of the frequency band 29.1-29.5 GHz (Earth-to-space) by the FSS is limited to GSO systems and feeder links to non-GSO systems in the MSS, in accordance with No. **5.535A**;

f) that WRC-15 adopted No. **5.527A** and Resolution **156 (WRC-15)** related to ESIMs that communicate with GSO satellites;

g) that advances in technology, including the use of tracing techniques, allow ESIMs to operate according to the characteristics of typical FSS earth stations;

h) that *these earth stations are not be used or relied upon for safety-of-life applications;*

i) that the frequency band 18.6-18.8 GHz is allocated to the EESS (passive) and space research service (SRS) (passive),

recognizing further

a) that segments of the frequency band 17.7-18.1 GHz are used by feeder links for the broadcasting-satellite service (BSS), subject to Appendix **30A** (No. **5.516**);

b) that the frequency bands 18.3-19.3 GHz (Region 2), 19.7-20.2 GHz (all regions), 27.5-27.82 GHz (Region 1), 28.35-28.45 GHz (Region 2), 28.45-28.94 GHz (all regions), 28.94-29.1 GHz (Regions 2 and 3), 29.25-29.46 GHz (Region 2) and 29.465-30.0 GHz (all regions) have been identified for use in high-density applications in the FSS (No. **5.516B**);

c) that the use of the frequency band 18.1-18.4 GHz by the FSS (Earth-to-space) is limited to feeder links of GSO BSS systems (No. **5.520**);

d) that the use of the frequency bands 17.8-18.6 GHz, 19.7-20.2 GHz, 27.5-28.6 GHz and 29.5-30.0 GHz by non-GSO FSS systems is subject to the applicable provisions of Nos. **5.484A**, **22.5C** and **22.5I**;

e) that the use of the frequency bands 18.8-19.3 GHz and 28.6-29.1 GHz by GSO and non-GSO FSS networks is subject to the applicable provisions of No. **9.11A**, while No. **22.2** does not apply (No. **5.523A**);

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* *Note by the Secretariat*: This Resolution was abrogated by WRC-19.

f) that the use of the frequency band 19.3-19.7 GHz by GSO FSS systems and feeder links of non-GSO MSS systems is subject to the applicable provisions of No. **9.11A**, but not to the provisions of No. **22.2**; in addition, the use of this frequency band by other non-GSO FSS systems or for the cases indicated in Nos. **5.523C** and **5.523E** is not subject to the provisions of No. **9.11A**, and shall continue to be subject to the procedures of Article **9** (except No. **9.11A**) and Article **11**, and to the provisions of No. **22.2** (No. **5.523D**);

g) that the frequency bands 27.5-29.1 GHz and 29.5-30.0 GHz may be used by the FSS (Earth-to-space) to provide feeder links in the BSS (No. **5.539**);

h) that all allocated services in the frequency bands referred to in *considering a)* to *e)* should be taken into account when conducting sharing and compatibility studies;

i) that the notifying administrations of those non-GSO FSS systems with which ESIMs in the frequency bands detailed in *considering a)* above are intended to operate should submit a commitment to ITU to undertake to immediately eliminate unacceptable interference or reduce it to an acceptable level should such interference be caused to terrestrial services;

j) that Resolution **2 (Rev.WRC-03)** resolves that "the registration with the Radiocommunication Bureau of frequency assignments for space radiocommunication services and their use do not provide any permanent priority for any individual country or groups of countries and do not create an obstacle to the establishment of space systems by other countries",

resolves to invite the ITU Radiocommunication Sector

1 **to study the technical and operational characteristics and user requirements of the different types of ESIMs that plan to operate within non-GSO FSS systems in the frequency bands 17.7-18.6 GHz, 18.8-19.3 GHz and 19.7-20.2 GHz (space-to-Earth) and 27.5-29.1 GHz and 29.5-30 GHz (Earth-to-space), or parts thereof;**

2 **to study sharing and compatibility between ESIMs operating with non-GSO FSS systems and current and planned stations of primary services allocated in the frequency bands 17.7-18.6 GHz, 18.8-19.3 GHz and 19.7-20.2 GHz (space-to-Earth) and 27.5-29.1 GHz and 29.5-30 GHz (Earth-to-space), or parts thereof, to ensure protection of, and not impose additional constraints on, GSO systems and other services, including terrestrial services, in those frequency bands and in adjacent frequency bands, including passive services;**

3 to develop the technical and regulatory provisions for the operation of aeronautical and maritime ESIMs with non-GSO FSS systems, taking into account the results of studies under *resolves to invite the ITU Radiocommunication Sector* 1 and 2;

4 to ensure that the technical and operational measures and the possible regulatory changes established in accordance with this Resolution shall not affect the relevant provisions related to the protection of GSO networks from non-GSO FSS systems;

5 to ensure that the results of ITU-R studies are agreed by Member States by consensus;

6 to complete the studies in time for WRC-23,

invites the 2023 World Radiocommunication Conference

to review the results of these studies and take appropriate action.

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ANNEXURE 3

NON GSO SATELLITES PERMITTED BY USA / FCC

US and International Satellite Operators are keen to apply and register their satellite networks with FCC as permitted satellites for providing services in US.

Many of these satellite operators participate actively in the FCC proceedings / discussions on satellite coordination matters.

FCC considerations are based on USA/FCC Rules and its Frequency Plan as well as ITU Regulations/International Coordination Considerations.

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Orbital Position	Satellite Name	Call Sign	Licensee or Grantee	Administration	Service	Frequency Range	Date In-orbit and Operating	Notes
NGSO	ONEWEB Ku-/Ka-BAND	S2963	WorldVu Satellites Limited, Debtor-in-Possession	United Kingdom	FSS	10.7-12.7 GHz (s-E) 14-14.5 GHz (E-s) 17.8-18.6 GHz (s-E) 18.8-19.3 GHz (s-E) 27.5-29.1 GHz (E-s) 29.5-30 GHz (E-s)	29-04-2019	720 satellites at an altitude of 1,200 km
NGSO	TELESAT Ka-BAND	S2976	Telesat LEO Inc.	Canada	FSS	17.8-18.6 GHz (s-E) 18.8-19.3 GHz (s-E) 19.7-20.2 GHz (s-E) 27.5-29.1 GHz (E-s) 29.5-30 GHz (E-s)	12-01-2018	72 satellites at an approx. altitude of 1,000 km 45 satellites at an approx. altitude of 1,248 km
NGSO	KEPLER	S2981	Kepler Communications Inc.	Canada	FSS	10.7-12.7 GHz (s-E) 14.0-14.5 GHz (E-s)	01/19/2018 (first satellite)	140 satellites at altitudes between 500-600 km

ITU REGULATORY PROCEDURES FOR NGSO SATELLITE SYSTEMS 24 OCTOBER 2021

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Orbital Position	Satellite Name	Call Sign	Licensee or Grantee	Administration	Service	Frequency Range	Date In-orbit and Operating	Notes
NGSO	SPACEX Ku/Ka-BAND	S2983 / S3018	Space Exploration Holdings, LLC	U.S.A.	FSS	10.7-12.7 GHz (s-E) 12.75-13.25 GHz 13.85-14.5 GHz (E-s) 17.8-18.6 GHz (s-E) 18.8-19.3 GHz (s-E) 19.7-20.2 GHz (s-E) 27.5-29.1 GHz (E-s) 29.5-30 GHz (E-s)	12-06-2019	4,408 satellites at altitudes at or below 580 km
NGSO	VIASAT	S2985	ViaSat, Inc.	Netherlands	FSS	17.8-18.6 GHz (s-E) 18.8-19.3 GHz (s-E) 19.7-20.2 GHz (s-E) 27.5-29.1 GHz (E-s) 29.5-30 GHz (E-s) 37.5-42 GHz (s-E) 47.2-50.2 GHz (E-s) 50.4-51.4 GHz (E-s)	Not yet launched	20 satellites at an altitude of 8,200 km
NGSO	TELESAT V-BAND	S2991	Telesat Canada	Canada	FSS	37.5-42 GHz (s-to-E) 47.2-50.2 GHz (E-to-s)	Not yet launched	117 satellites

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Orbital Position	Satellite Name	Call Sign	Licensee or Grantee	Administration	Service	Frequency Range	Date In-orbit and Operating	Notes
NGSO	SPACEX Ku/Ka-BAND	S2983 / S3018	Space Exploration Holdings, LLC	U.S.A.	FSS	10.7-12.7 GHz (s-E) 12.75-13.25 GHz 13.85-14.5 GHz (E-s) 17.8-18.6 GHz (s-E) 18.8-19.3 GHz (s-E) 19.7-20.2 GHz (s-E) 27.5-29.1 GHz (E-s) 29.5-30 GHz (E-s)	12-06-2019	4,408 satellites at altitudes at or below 580 km
NGSO	VIASAT	S2985	ViaSat, Inc.	Netherlands	FSS	17.8-18.6 GHz (s-E) 18.8-19.3 GHz (s-E) 19.7-20.2 GHz (s-E) 27.5-29.1 GHz (E-s) 29.5-30 GHz (E-s) 37.5-42 GHz (s-E) 47.2-50.2 GHz (E-s) 50.4-51.4 GHz (E-s)	Not yet launched	20 satellites at an altitude of 8,200 km
NGSO	TELESAT V-BAND	S2991	Telesat Canada	Canada	FSS	37.5-42 GHz (s-to-E) 47.2-50.2 GHz (E-to-s)	Not yet launched	117 satellites

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SpaceX / Starlink Major Parameters

(Extract from FCC List of NGSO Satellites permitted by USA)

Orbital Position	Satellite Name	Call Sign	Licensee or Grantee	Administration	Service	Frequency Range	Date In-orbit and Operating	Notes
NGSO	SPACEX Ku/Ka-BAND	S2983 / S3018	Space Exploration Holdings, LLC	U.S.A.	FSS	10.7-12.7 GHz (s-E) 12.75-13.25 GHz 13.85-14.5 GHz (E-s) 17.8-18.6 GHz (s-E) 18.8-19.3 GHz (s-E) 19.7-20.2 GHz (s-E) 27.5-29.1 GHz (E-s) 29.5-30 GHz (E-s)	12-06-2019	4,408 satellites at altitudes at or below 580 km

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